

WHAT IS CLAIMED IS:

1        1. A method of retaining an active subscriber  
2        record in a Home Location Register (HLR) for a mobile  
3        station operating in a radio telecommunications network  
4        when the mobile station switches from a voice mode to a  
5        data mode, said method comprising the steps of:

6                transmitting from the mobile station to a serving  
7        base station, a power-down registration message that  
8        includes a Data Mode Indicator (DMI);

9                sending the power-down registration message and DMI  
10      from the base station to a serving Mobile Switching  
11      Center (MSC);

12                sending from the MSC to the HLR, a registration  
13      cancellation message that includes the DMI; and

14                in response to receiving the DMI, setting an  
15      indicator in the subscriber record in the HLR indicating  
16      that the mobile station is operating in the data mode.

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1           2. A method of preventing a call-setup timer in an  
2 interrogating Mobile Switching Center (MSC) from expiring  
3 when an incoming voice call is made to a called mobile  
4 station (MS) that is operating in a data mode in a radio  
5 telecommunications network having a voice network portion  
6 and a data network overlay, said voice network portion  
7 including a Home Location Register (HLR) for the called  
8 MS, said method comprising the steps of:

9           setting an indicator in the HLR indicating that the  
10 called MS is operating in the data mode;

11          receiving in the interrogating MSC, the voice call  
12 from the calling MS;

13          sending a location request message from the  
14 interrogating MSC to the HLR;

15          determining from the indicator in the HLR that the  
16 called MS is operating in the data mode;

17          sending from the HLR to the interrogating MSC, a  
18 first response to the location request message, said  
19 first response directing the interrogating MSC to wait  
20 for a second response; and

21          suspending the call-setup timer in the interrogating  
22 MSC.

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1           3. The method of claim 2 wherein the step of  
2 setting an indicator in the HLR indicating that the  
3 called MS is operating in the data mode includes  
4 receiving in the HLR a Data Mode Indicator (DMI) from the  
5 called MS, said DMI being sent by the called MS when  
6 switching to the data mode.

1           4. A method of notifying a called mobile station  
2 (MS) that an incoming voice call from a calling MS is  
3 waiting when the called MS is operating in a data mode in  
4 a radio telecommunications network having a voice network  
5 portion and a data network overlay, said voice network  
6 portion including a Home Location Register (HLR) for the  
7 called MS, said method comprising the steps of:

8           setting an indicator in the HLR indicating that the  
9 called MS is operating in the data mode;

10          sending a location request message from an  
11 interrogating Mobile Switching Center (MSC) to the HLR;

12          determining from the indicator in the HLR that the  
13 called MS is operating in the data mode; and

14          sending from the HLR through the data network  
15 overlay to the called MS, an indication that the voice  
16 call is waiting.

1       5. The method of claim 4 wherein the step of  
2 setting an indicator in the HLR indicating that the  
3 called MS is operating in the data mode includes  
4 receiving in the HLR a Data Mode Indicator (DMI) from the  
5 called MS, said DMI being sent by the called MS when  
6 switching to the data mode.

1       6. The method of claim 4 further comprising  
2 preventing a call-setup timer in the interrogating MSC  
3 from expiring while the indication that the voice call is  
4 waiting is sent to the called MS.

1       7. The method of claim 6 wherein the step of  
2 preventing the call-setup timer from expiring includes  
3 the steps of:

4             sending from the HLR to the interrogating MSC, a  
5 first response to the location request message, said  
6 first response directing the interrogating MSC to wait  
7 for a second response; and

8             suspending the call-setup timer in the interrogating  
9 MSC.

1        8. A method of setting up an incoming voice call  
2 from a calling mobile station (MS) to a called MS that is  
3 operating in a data mode in a radio telecommunications  
4 network having a voice network portion and a data network  
5 overlay, said voice network portion including a first  
6 Mobile Switching Center (MSC-1) serving the called MS, a  
7 Home Location Register (HLR) that stores a user record  
8 for the called MS, and a second MSC (MSC-2) serving a  
9 calling MS, and said data network overlay including a  
10 Mobile Data Immediate System (MDIS) serving the called MS  
11 and a gateway connecting the MDIS to an Internet Protocol  
12 (IP) network, said method comprising the steps of:  
13              notifying the called MS that the incoming voice call  
14 is waiting;  
15              determining whether the called MS accepted the  
16 incoming voice call;  
17              preventing a call-setup timer in MSC-2 from expiring  
18 while notifying the called MS that the incoming voice  
19 call is waiting and while determining whether the called  
20 MS accepted the incoming voice call; and  
21              delivering the incoming voice call to the called MS  
22 upon determining that the called MS accepted the incoming  
23 voice call.

1           9. The method of claim 8 further comprising the  
2 step of retaining an active user record in the HLR for  
3 the called MS when the called MS switches from a voice  
4 mode to the data mode, said record indicating that the  
5 called MS is operating in the data mode.

1           10. The method of claim 9 wherein the step of  
2 retaining an active user record in the HLR for the called  
3 MS includes the steps of:

4           transmitting from the mobile station to a serving  
5 base station, a power-down registration message that  
6 includes a Data Mode Indicator (DMI);

7           sending the power-down registration message and DMI  
8 from the base station to MSC-1;

9           sending from MSC-1 to the HLR, a registration  
10 cancellation message that includes the DMI; and

11          in response to receiving the DMI, setting an  
12 indicator in the user record in the HLR indicating that  
13 the mobile station is operating in the data mode.

1           11. The method of claim 8 wherein the step of  
2 notifying the called MS that the incoming voice call is  
3 waiting includes the steps of:

4           determining from the user record in the HLR that the  
5 called MS is operating in the data mode; and

6            sending from the HLR through the data network  
7        overlay to the called MS, an indication that the voice  
8        call is waiting.

1            12. The method of claim 8 wherein the step of  
2        preventing a call-setup timer in MSC-2 from expiring  
3        includes the steps of:

4            receiving in MSC-2, the voice call from the calling  
5        MS;

6            sending a location request message from MSC-2 to the  
7        HLR;

8            determining from the user record in the HLR that the  
9        called MS is operating in the data mode;

10          sending from the HLR to MSC-2, a first response to  
11        the location request message, said first response  
12        directing MSC-2 to wait for a second response; and  
13          suspending the call-setup timer in MSC-2.

1            13. The method of claim 8 further comprising  
2        placing an ongoing data call on hold upon determining  
3        that the called MS accepted the incoming voice call.

1           14. The method of claim 13 further comprising the  
2 steps of:

3           determining that the called MS is switching back to  
4 the data mode; and

5           reconnecting the ongoing data call on hold.

1           15. A method of setting up an incoming voice call  
2 from a calling mobile station (MS) to a called MS that is  
3 operating in a data mode in a radio telecommunications  
4 network having a voice network portion and a data network  
5 overlay, said voice network portion including a first  
6 Mobile Switching Center (MSC-1) serving the called MS, a  
7 Home Location Register (HLR) for the called MS, and a  
8 second MSC (MSC-2) serving a calling MS, and said data  
9 network overlay including a Mobile Data Immediate System  
10 (MDIS) serving the called MS and a gateway connecting the  
11 MDIS to an Internet Protocol (IP) network, said method  
12 comprising the steps of:

13           setting an indicator in the HLR indicating that the  
14 called MS is operating in the data mode;

15           receiving in MSC-2, the voice call from the calling  
16 MS;

17           sending a location request message from MSC-2 to the  
18 HLR;

19           determining from the indicator in the HLR that the  
20 called MS is operating in the data mode;

21            sending from the HLR through the data network  
22        overlay to the called MS, an indication that the voice  
23        call is waiting;

24            sending from the HLR to the interrogating MSC, a  
25        first response to the location request message, said  
26        first response directing the interrogating MSC to wait  
27        for a second response;

28            suspending the call-setup timer in the interrogating  
29        MSC;

30            determining by a voice/data application server in  
31        the data network overlay, whether the called MS accepted  
32        the incoming voice call;

33            placing an ongoing data call on hold by the  
34        application server, upon determining that the called MS  
35        accepted the incoming voice call;

36            determining by the HLR, whether the called MS  
37        accepted the incoming voice call; and

38            upon determining that the called MS accepted the  
39        incoming voice call:

40            obtaining by the HLR, a routing number for the  
41        called MS from MSC-1;

42            sending a second response to MSC-2, said second  
43        response including the routing number for the called MS;  
44        and

45            routing the voice call to the called MS.

1           16. The method of claim 15, wherein the step of  
2 determining whether the called MS accepted the incoming  
3 voice call includes receiving in the HLR, a registration  
4 message from the called MS.

1           17. The method of claim 15, wherein the step of  
2 determining whether the called MS accepted the incoming  
3 voice call includes receiving in the HLR, an indication  
4 from the called MS, routed through the MDIS and gateway,  
5 that the called MS did not accept the incoming voice  
6 call.

1           18. The method of claim 17 further comprising, upon  
2 determining that the called MS did not accept the  
3 incoming voice call, sending a second response to MSC-2,  
4 said second response including an indication that the  
5 called MS did not accept the incoming voice call.

1           19. A method of setting up an incoming data call  
2 from a calling mobile station (MS) to a called MS that is  
3 operating in a voice mode in a radio telecommunications  
4 network having a voice network portion and a data network  
5 overlay, said voice network portion including a first  
6 Mobile Switching Center (MSC-1) serving the called MS, a  
7 Home Location Register (HLR) for the called MS, and a

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8 second MSC (MSC-2) serving a calling MS, and said data  
9 network overlay including a Mobile Data Immediate System  
10 (MDIS) serving the called MS and a gateway connecting the  
11 MDIS to an Internet Protocol (IP) network, said method  
12 comprising the steps of:

13 sending a Short Message Service (SMS) message  
14 containing a Data Waiting Indicator (DWI) to the called  
15 MS;

16 determining whether the called MS accepted the  
17 incoming data call; and

18 routing the incoming data call to the called MS upon  
19 determining that the called MS accepted the incoming data  
20 call.

1 20. The method of claim 19 further comprising,  
2 before the step of sending an SMS message, the steps of:

3 receiving the incoming data call in an application  
4 server in the data network overlay; and

5 sending a data waiting message from the application  
6 server to a message center (MC) in the voice network  
7 portion.

1 21. The method of claim 19 further comprising  
2 placing an ongoing voice call on hold upon determining  
3 that the called MS accepted the incoming data call.

1           22. The method of claim 21 further comprising the  
2 steps of:

3           determining that the called MS is switching back to  
4 the voice mode; and

5           reconnecting the ongoing voice call on hold.

1           23. A system for setting up an incoming voice call  
2 from a calling mobile station (MS) to a called MS that is  
3 operating in a data mode in a radio telecommunications  
4 network having a voice network portion and a data network  
5 overlay, said voice network portion including a first  
6 Mobile Switching Center (MSC-1) serving the called MS, a  
7 Home Location Register (HLR) for the called MS, and a  
8 second MSC (MSC-2) serving a calling MS, and said data  
9 network overlay including a Mobile Data Immediate System  
10 (MDIS) serving the called MS and a gateway connecting the  
11 MDIS to an Internet Protocol (IP) network, said system  
12 comprising:

13           an indicator in a user record in the HLR for the  
14 called MS that indicates that the called MS is operating  
15 in the data mode;

16           a voice/data application server in the data network  
17 overlay that receives a notification from the HLR that  
18 the voice call is waiting, and sends the notification  
19 through the data network overlay to the called MS;

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20           a signaling mechanism in the HLR that receives a  
21 registration message from the called MS indicating that  
22 the called MS accepted the incoming voice call;

23           call processing logic in the HLR that prevents a  
24 call-setup timer in MSC-2 from expiring while the called  
25 MS is notified that the incoming voice call is waiting,  
26 and while it is determined whether the called MS accepted  
27 the incoming voice call, said logic sending a first  
28 response message to MSC-2 instructing MSC-2 to suspend  
29 the timer until a second response message is received;  
30 and

31           a signaling mechanism in the HLR for obtaining a  
32 routing number for the called MS from MSC-1, and  
33 returning the routing number to MSC-2 in the second  
34 response message.

1           24. A system for setting up an incoming data call  
2 from a calling mobile station (MS) to a called MS that is  
3 operating in a voice mode in a radio telecommunications  
4 network having a voice network portion and a data network  
5 overlay, said voice network portion including a first  
6 Mobile Switching Center (MSC-1) serving the called MS, a  
7 Home Location Register (HLR) for the called MS, and a  
8 second MSC (MSC-2) serving a calling MS, and said data  
9 network overlay including a Mobile Data Immediate System  
10 (MDIS) serving the called MS and a gateway connecting the

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11 MDIS to an Internet Protocol (IP) network, said system  
12 comprising:

13 a message center that sends a Short Message Service  
14 (SMS) message containing a Data Waiting Indicator (DWI)  
15 to the called MS;

16 a signaling mechanism in MDIS-1 for receiving a  
17 registration message from the called MS, and for sending  
18 the registration message to a voice/data application  
19 server in the data network, said registration message  
20 indicating that the called MS accepted the incoming data  
21 call; and

22 a voice/data application server in the data network  
23 overlay that receives the incoming data call from MDIS-2  
24 and sends a data waiting message to the MC, said  
25 application server also routing the incoming data call to  
26 the called MS after the registration message indicates  
27 that the called MS accepted the incoming data call.